REVIEW ARTICLE

INGESTIBLE ELECTRONICALLY CONTROLLED DRUG- CAPSULE IN THE Gut

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ABSTRACT

The Ingestible Electronically Controlled Drug-delivery System consists of electronically design capsule that navigates the digestive system by assessing human pH levels, which it reads through pH sensors. When the pH sensors identify a specified pH level that indicates arrival at the destination, the e-Capsule begins dispensing medication which it can do all immediately, in a sustained released, extended release or controlled release form. When it is activated, they send messages to a detector located on the patient's body that can send e-mails or text messages to doctors or Pharmacist notifying them the effect of medication that has been taken and they altered the medication accordingly if needed. Researchers are hopeful that this technology will improve medication observance, targeted drug delivery and drug of choice.

Keywords: Electronically Controlled drug Delivery System

INTRODUCTION

Ingestible Electronically Controlled Drug Capsule is the targeted delivery of drug in the Gut. It consists of an ingestible capsule consisting of a pH sensor which release drug in a particular pH, thermosensors which monitor temperature of body, battery which provide continuous power supply to the capsule, Fluid Pump, Drug Reservoir and Dispensing hole. By the help of gut pH, pressure and temperature a wireless motility capsule has been established. It has been constructed to be engulfed and didn't interfere the natural human digestive system[1]. The scheme comprises of a digestible antenna and microchip to a normal-size shell. When we ingest the pill then it starting working by producing the signals which is receiving by a small electronic device supported by the patient. This device is linked with laptop, cell phone or computer, alerting doctors and family member[2].

Advantages of e-Capsule:

It has potentials to be a valuable research tool for the development of any new drug that is delivered through intestinal tract. With help of this device the location in the gut can be determined with good accuracy[3]. It has been developed to measure transit time[4]. It will help effortlessly to attain data on the intestinal absorption of a drug in humans. It will help to communicate the patient with the Physician and the Pharmacist through mobile or laptop. It is used to locally treat a medical condition.

Problem Statement

The problem with administering numerous medications orally is that a pill often will not dissolve at precisely the right site in the gastrointestinal tract where the medicine can be absorbed into the bloodstream[5]

LITERATURE REVIEW

Physical delivery of Pharmaceutical agent:

Zdeblick Mark and his co-worker have developed Compositions, systems and methods that suggested the identification of the actual physical delivery of a pharmaceutical agent to a body. It includes an identifier and an active agent. The innovator finds use in a variety of different applications such as monitoring of therapeutic regimen compliance and tracking the history of pharmaceutical agent[6].

Analyte monitoring and drug delivery system:

Holmes Elizabeth and his co-worker have work on the analyte monitoring and drug delivery system. The innovation narrates to an ingestible, implantable or wearable medical device consisting of a microarray which encompasses a bioactive agent able of interacting with a disease marker biological analyte. Mechanism includes a reservoir that contains with minimum one therapeutic mediator and has the capacity of releasing the therapeutic mediator from the medical gadgets and numerous microchips consisting of a microarray scanning instrument that have the ability of analysing the physical parameter data of a communication between the disease marker biological analyte with the bioactive agent. It also contains a biometric recognition device proficient of linking the physical parameter data with an analyte interaction profile; an outer surface gadget capable of helping interaction between the biometric recognition device, microarray scanning device, and the therapeutic agent; and a power source to control the medical gadgets[7].

Remote Controlled Capsule:

Remote Controlled Capsule (RCC) is a new technique to understand non-invasive drug delivery to the specific locations of human gut. Human Drug Absorption (HDA) studies are taken effortlessly to attain data on the intestinal absorption of a drug in humans. This system has been prearranged using MEMS technology to make available for the delivery of an extensive choice of different drug formulations. A magnetic Marker Monitoring (MMM) system was established to monitor the place of the capsule inside the gut. A new method to indicate the drug release, called as Indicating System built on Abrupt Movement of Marker (ISAMM), was proposed in this study. It has been proved by animal models[8].

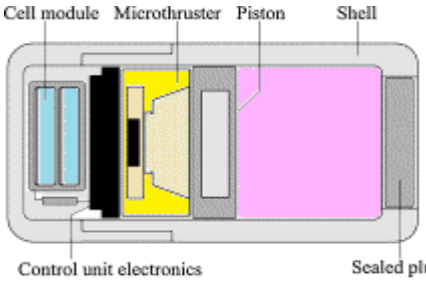

Figure 1: Novel Micro-Fabricated Thruster For Drug Release In Remote Controlled Capsule

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Magnetic marker monitoring:

A patented remote controlled capsule (RCC) has newly been design to provide noninvasive drug delivery to certain sites in the human gut that allows assessment of local gastrointestinal (GI) drug absorption under a normal physiological environment. For this purpose rate and extent of aminophylline absorption after site-specific delivery of the drug in the GI tract has been studied using RCC and a magnetic marker monitoring (MMM) technique. After this study it was found that the proprietary of the RCC and MMM technique offer the chance to gain data on the intestinal absorption of a drug in humans under noninvasive conditions. Aminophylline is quickly and well absorbed from the small bowel. While colonic absorption was restricted by the poor water condition although effective absorption was observed from the ascending colon. This offers a chance for rational development of modified-release formulations as well as alternative dosage forms[9].

Intelligent Pill:

After the approval of the first camera pill by Federal Drug Administration in 2001 for diagnostic purposes, many researchers are then working to design such pill that also have the capability to deliver the drug. After seven years the efforts succeed and a renowned organization has developed an intelligent pill which can be electronically programmed to control the drug delivery to a pre-defined rate in the Gut. It can be monitor easily and also identified its location by attaching different sensors such as temperature sensor and pH sensors which is used to track the drug and also aid when to release the drug in the Gut. The iPill discharges medicine from its drug reservoir through microprocessor scaled pump, letting accurate programmable drug delivery. It also have the ability to measure the temperature and pH[10].

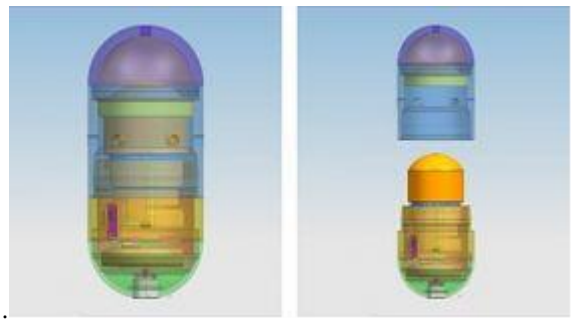

Figure 2: iPill

Magnetic Pill System:

Brown University researchers are working with the problem that orally administered drug will never dissolved at appropriate site in the Gut. They succeeded to solve this problem by developing a new magnetic pill system. This has opened a big horizon in the field of research. The system comprises of gelatin capsules along with a tiny magnet and an external magnet that can precisely sense the force between them. The pill deviate that force where needed to grip the pill in place. The exterior magnets can intellect the pill's position. To avoid any injury to nearby tissue we have to monitor the force that are applying through external magnet. To avoid this Bryan Laulicht took careful dimensions and made an external magnet structure with sensitive computer regulator and feedback mechanisms[11].

Ingestible event marker (IEM) system:

An Ingestible event marker (IEM) system is design by an organization that covers a personal signal receiver and an ingestible event marker. It is activated upon contact with a target interior physiological site of a body like digestive tract internal target site. The personal signal receiver is aimed to be related with a physiological location such as inside of or on the body and to receive a signal through IEM. The IEM programmes a signal which is received by the personal signal receiver[12]. An ingestible therapy activator system and method are one aspect of the ingestible therapy activator that includes an ingestible device having an effector module to send an effector instruction and a responder module related with a therapeutic device. The responder module may receive and process the effector instruction, resulting in a response by the therapeutic device such as therapeutic device include activating a therapy, deactivating a therapy, modulating a therapy, and discontinuing a therapy[13]. Ingestible event markers having high reliability are provided. Aspects of the ingestible event markers comprise a support, a control circuit, a first electrochemical material, a second electrochemical material and a membrane. In addition, the ingestible event markers might comprise one or more components that impart high reliability to the ingestible event marker. Further, the ingestible event markers may contain an active agent. In some aspects, the active agent, such as a pharmaceutically active agent or a diagnostic agent may be associated with the membrane[14].

A Miniaturized Electronic Device:

A miniaturized in-body electronic device is provided containing one or more antennas may be galvanically joined to receive an alternating current (AC) signal through the body of a subject where the in-body electronic device is located. Power extraction circuitry is configured to extract electrical power from the AC signal received by the antenna. The extracted electrical power is used for electrically powering one or more components of the electronic device. A transmitter is coupled to receive power from the power extraction circuitry. A controller is coupled to the transmitter. The controller is configured to activate the transmitter to generate a sequence of intermittent transmission bursts for transmitting an uplink signal; a transmission burst may have a higher instantaneous power level than an instantaneous power level of the AC signal received by the antenna[15].

Tepper Robert and his co-workers:

Tepper Robert and his co-workers describe a devices, systems, and kits for delivering substances to tissues. The devices usually include one or more chambers and a reservoir within each chamber. The reservoir may locally deliver a micro dose amount of a substance to a target tissue. In some variations, a micro dose amount is used in early human studies, e.g., before a phase I clinical trial, to evaluate the effect of the substance on a target tissue, or to obtain pharmacokinetic or metabolic data. In other variations, a micro dose quantity is used to locally treat a medical condition. In yet other variations, a micro dose amount is used to locally deliver a contrast agent for a structural or functional imaging procedure. Methods for delivering and retrieving the devices from the target tissue are also described[16].

Electronic Control of Drug Delivery System:

Saad David and his co-worker explain a drug delivery device for driving an electrotransport current through a body surface of a user is provided. The device contains a patch with two electrodes and one or more reservoirs storing a therapeutic agent. The one or more reservoirs release the therapeutic agent into the body surface of the user when the reservoirs are located over the electrodes to create an electrical path for the electrotransport current. The device consists of a controller

which regulates a controllable power supply to drive the electrotransport current through the body surface of the user in a programmed profile[17].

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Figure 3: External Core of Capsule

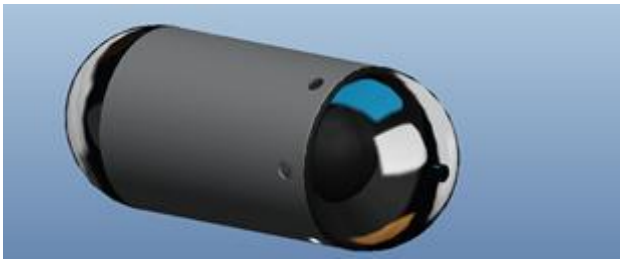

Figure 4: External Core of Capsule

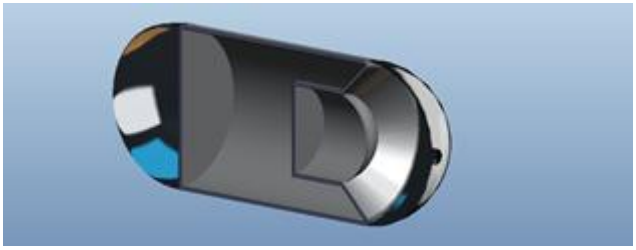

Figure 5: Internal Core of Capsule

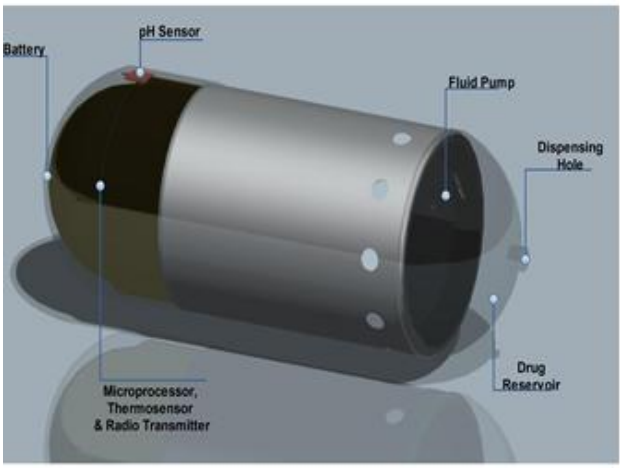

Figure 6: Labelling of Capsule

DISCUSSION

Electronically drug delivery system will bring new horizon in the target drug delivery system. It is beneficial to monitor the drug delivery in the Gut and also helps to improve the therapeutically drug regimen. If the capsule is introduced in the blood through microencapsulation then it will helps in the Physician and Pharmacist to monitor the drug throughout the body compartment and it is used as research tools for clinical trials. The purposed structure for the electronically controlled drug capsule is as follows

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